STANDARD URBAN STORMWATER MITIGATION PLAN

PROJECT
722 KNOB HILL AVENUE
REDONDO BEACH, CA 90277

July 22, 2011

OWNER
ST. KATHERINE GREEK ORTHODOX CHURCH
722 KNOB HILL AVENUE
REDONDO BEACH, CA 90277

ENGINEER
DENN ENGINEERS
3914 DEL AMO BLVD., STE 921
TORRANCE, CA 90503

REGISTERED PROFESSIONAL ENGINEER
GARY J. ROEHL
No. 30826
Exp. 03-31-12
CIVIL
STATE OF CALIFORNIA

PROJECT DESCRIPTION

The existing and proposed project is a church facility/campus. The intent of the project is to upgrade the existing facility, increase the kitchen size, upgrade handicap bathrooms and accessibility and update the façade and entry of the Campus. The existing drainage patterns will remain the same. The existing and proposed paved areas will be the same. The flow patterns will be the same. There will not be any significant grading or earth movement occurring. The large patio area grade will essentially be the same – dips and raised areas due to settlement will be corrected to establish as more even surface.

Construction is proposed for on-site only. No work is proposed in the city right-of-way.

SITE CONDITION

The existing church campus has two parking lots, one on the west side and one on the east side. The church building consists of one large, single story structure along the northerly portion of the land consisting of the church sanctuary, church hall, kitchen and offices. There are two accessory buildings; one is a two story classroom and meeting room facility, the second is a single story classroom facility.

PROPOSED CONDITION

The proposed facility is being updated to meet handicap accessibility, one of the old classroom buildings is being demolished, and the existing kitchen is being demolished. A new kitchen will be built, an addition to the two-story classroom is being added, and a new entry and Naïve will be constructed. New landscaping and entry approach will also be constructed.

There will be no construction on the westerly side of the campus (west parking lot) as this was redone in 2010 under a separate SUSMP. There will also be no construction on the easterly side of the campus (east parking lot).

FLOW PATTERNS

The existing drainage patterns will not be changed.

ANTICIPATED POLLUTANTS

There are no unusual pollutants anticipated from this site. We expect minimal pollutants from the parking area to be: sediments, trash and debris, oil and grease.

The pollutants will be addressed by use of Cultec systems installed in the east parking lot and/or by filtration through natural materials.

BMP's

Design Standards for Treatment Control BMP: Design standards for treatment of storm runoff are based on the volume of runoff produced from 0.75 inch storm event.

Proper Design of Parking Area: To treat the storm runoff before it reaches any public storm drain system.

Proper Design to Limit Oil Contamination and Perform Maintenance: The owner shall remove oil and petroleum hydrocarbons from the parking areas that have heavy usage.

Provide Proof of Ongoing BMP Maintenance: Upon request of the city, the developer's signed statement (Maintenance Covenant) accepting responsibility for maintenance shall be on file with the city of Redondo Beach.

Stenciling and Signage: Any new catch basins shall be stenciled with prohibitive language "NO DUMPING – DRAINS TO OCEAN"

Minimizing Pollutants: Media filtration and basket inserts may be used to minimize/remove oil and grease, trash and sediments from storm runoff before entering into the storm water retention areas and before discharge to public storm drain systems. Where possible, natural methods of water filtration shall be used (natural filtration over landscaped areas).

Peak Storm Water Runoff Discharge Rates: The proposed discharge of storm water from any one device to any public right-of-way shall not exceed the City of Redondo Beach current requirements of 1 cfs.

FILTRATION AND INFILTRATION

Where possible, roof water and surface water will be directed across landscaping areas. The residual water will then be discharged to the street through parkway drains or directed to the Cultec system.

A Cultec system shall be installed with discharge through an existing parkway outlet in the curb face at the northeast area of the site (the current location of onsite water discharge).

FIRST FLUSH CALCULATIONS

Total site area = 1.199 Acres

Area A (Existing west parking lot) = 0.28 Acres - no construction

Area B (front landscape area) = 0.254 Acres. This area will run across landscaping/grass areas before discharge to the street through catch basins and outlets through the curb face.

Area C (main area of the campus) = 0.455 Acres. The first ¾" of rainfall will be collected and stored in a Cultec system in the east parking lot.

Storage calculations from "Mitigated Stormwater Runoff Volume Calculations Section C" (required):

1,017 CF

Absorption calculations:

Using the absorption rate from the UPC for Fine Sand soil = 4.0 gal/SF
Cultec system area = (11' x 50') = 550 SF
4.0 gal/SF x 550 SF = 2,200 gal
2,200 gal / 7.44 gal/cf = 296 CF of absorption

1,017 CF – 296 CF = 721 CF of storage required

Required Cultec units:

The Cultec HD280 system comes in eight (8) foot lengths. Each length segment can hold 64.5 CF. Therefore, 721 CF / 64.5 CF = 11 units required.

Area D (Existing east parking lot) = 0.21 Acres - no construction

STANDARD URBAN STORMWATER MITIGATION PLAN (SUSMP)
FLOW RATE FOR 0.75" OF RAINFALL
PER L.A.C.D.P.W. METHOD

PROJECT CHARACTERISTICS

Denn Job #: 11-198

Section: B

Type of Development: CHURCH

Predominate Soil Type: 10 Oakley Fine Sand

% Project Impervious = 29.9%

% Project Pervious = 70.1%

% Project Undev. Contrib. = 0.0%

Length = 20.0 ft.

% Slope = 15.0

A_I = 0.076 Acres

A_P = 0.178 Acres

A_U = 0.000 Acres

A_{total} = 0.254 Acres

TABLE FOR ITERATIONS: (Iterate until Difference < 0.50)

Iteration No.	Initial T_c (min)	I_x (in/hr)	C_U	C_D	$C_D * I_x$ (in/hr)	Calculated T_c (min)	Difference (min)
1	3.0	0.447	0.10	0.339	0.1517	4.5	1.5
2	4.5	0.447	0.10	0.339	0.1517	4.5	0.0
3							
4							
5							
6							
7							

I_x from Table I, Intensity - Duration Data for 0.75-Inches of Rainfall for all Rainfall Zones

CU from Runoff Coefficient Curve for Soil Type No. 10 (Appendix D-29)**

$C_D = (0.9 * \%Imp) + (1.0 - \%Imp)\, C_U$

$T_c = 10^{(-0.507)} * (C_D * I_x)^{(-0.519)} * Length^{(0.483)} * Slope^{(-0.135)}$

Acceptable T_C Value = 5 min

Peak Mitigation Flow Rate Q_{PM} = CD * Ix * A_{total}

Q_{PM} = 0.039 cfs

Mitigated Stormwater Runoff Volume

V_M = (2,722.5 ft^3/acre) * $[A_I*0.9+(A_P+A_U)*C_U]$

V_M = 234.7 ft^3

** Appendix references from LACDPW Hydrology/Sedimentation Manual

STANDARD URBAN STORMWATER MITIGATION PLAN (SUSMP)
FLOW RATE FOR 0.75" OF RAINFALL
PER L.A.C.D.P.W. METHOD

PROJECT CHARACTERISTICS

Denn Job #: 11-198

Section: C

Type of Development: CHURCH

Predominate Soil Type: 10 Oakley Fine Sand

% Project Impervious = 90.1%

% Project Pervious = 9.9%

% Project Undev. Contrib. = 0.0%

Length = 240.0 ft.

% Slope = 5.0

A_I = 0.410 Acres

A_P = 0.045 Acres

A_U = 0.000 Acres

A_{total} = 0.455 Acres

TABLE FOR ITERATIONS: (Iterate until Difference < 0.50)

Iteration No.	Initial T_c (min)	I_x (in/hr)	C_U	C_D	$C_D * I_x$ (in/hr)	Calculated T_c (min)	Difference (min)
1	10.0	0.323	0.10	0.821	0.2651	13.1	3.1
2	13.1	0.285	0.10	0.821	0.2339	14.0	0.9
3	14.0	0.276	0.10	0.821	0.2267	14.2	0.2
4							
5							
6							
7							

I_x from Table I, Intensity - Duration Data for 0.75-Inches of Rainfall for all Rainfall Zones

CU from Runoff Coefficient Curve for Soil Type No. 10 (Appendix D-29)**

$C_D = (0.9 * \%Imp) + (1.0 - \%Imp)\ C_U$

$T_c = 10^{(-0.507)} * (C_D * I_x)^{(-0.519)} * Length^{(0.483)} * Slope^{(-0.135)}$

Acceptable T_C Value = 14 min

Peak Mitigation Flow Rate Q_{PM} = CD * Ix * A_{total}

Q_{PM} = 0.104 cfs

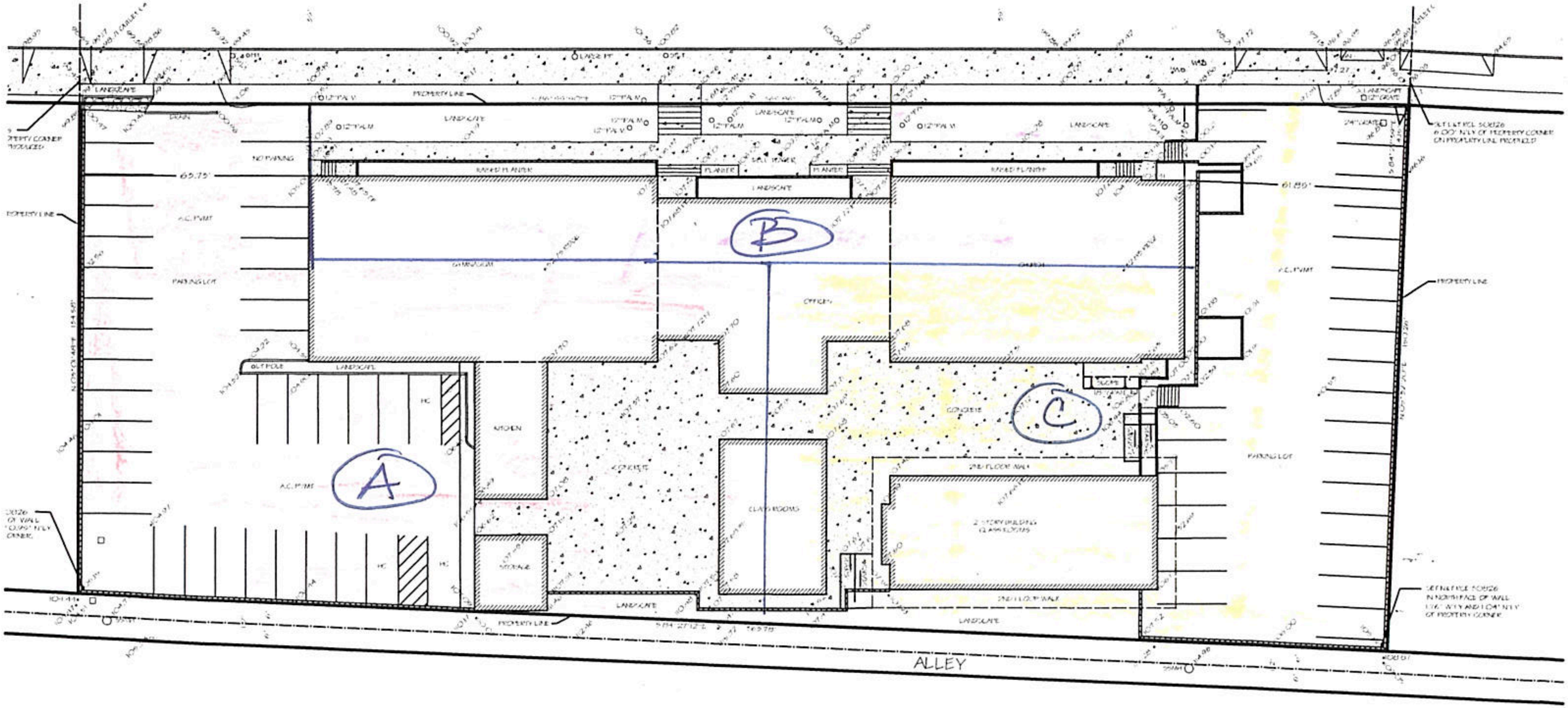
Mitigated Stormwater Runoff Volume

V_M = (2,722.5 ft^3/acre) * $[A_I*0.9+(A_P+A_U)*C_U]$

V_M = 1016.9 ft^3

** Appendix references from LACDPW Hydrology/Sedimentation Manual

Existing



A
B
C
ALLEY
PROPERTY LINE
PARKING LOT
A.C. PVMT
GYMNASIUM
OFFICES
CHURCH
KITCHEN
STORAGE
CLASSROOMS
2 STORY BUILDING CLASSROOMS
2ND FLOOR WALK
CONCRETE
LANDSCAPE
RAISED PLANTER
PLANTER
NO PARKING
65.75'
61.89'
HC

PROPOSED

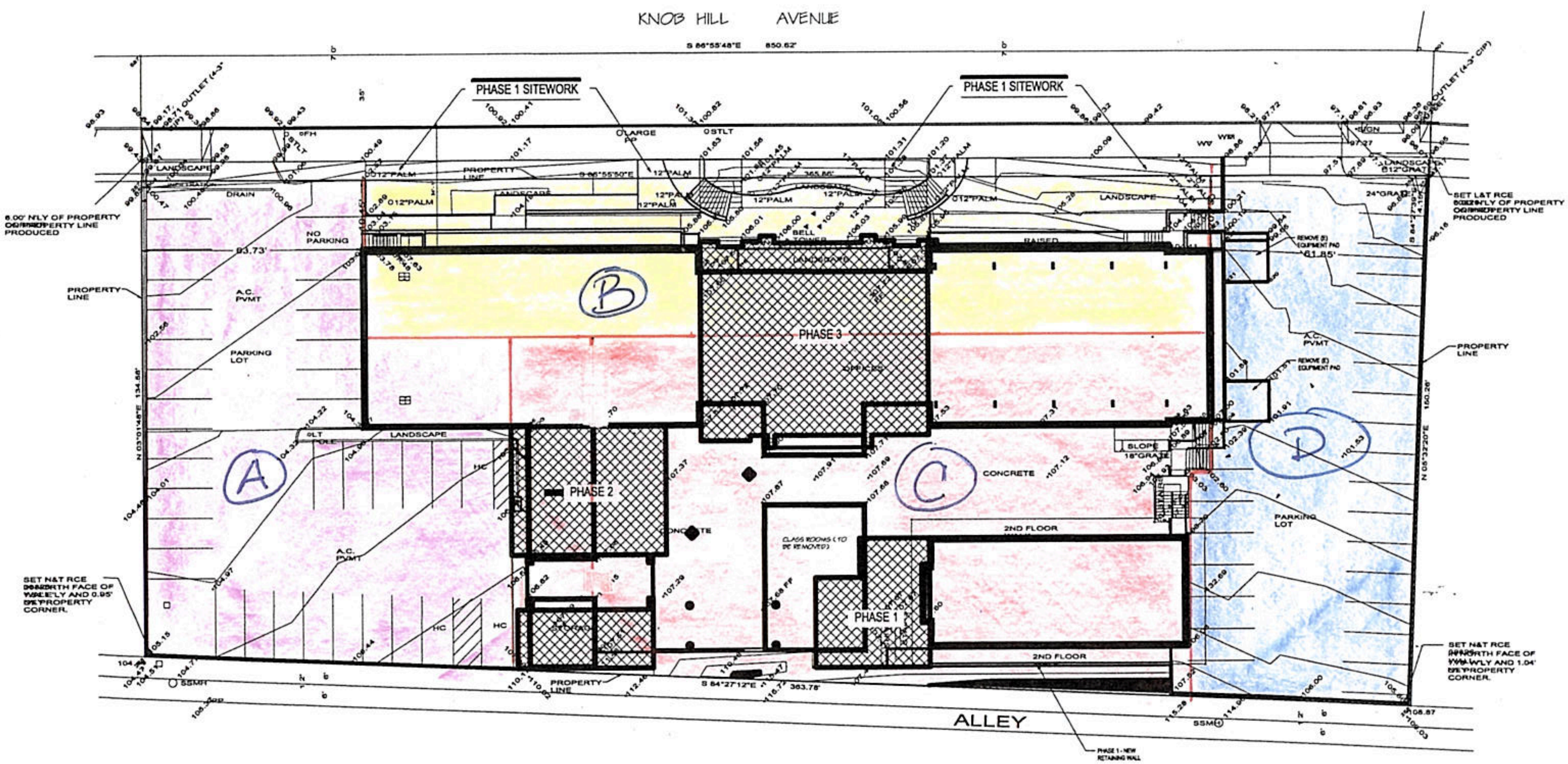

KNOB HILL AVENUE
S 86°55'48"E 850.62'
PHASE 1 SITEWORK
PHASE 1 SITEWORK
6.00' N'LY OF PROPERTY LINE PRODUCED
PROPERTY LINE
A.C. PVMT
PARKING LOT
NO PARKING
LANDSCAPE
DRAIN
B
PHASE 3
A
PHASE 2
C
CONCRETE
2ND FLOOR
PHASE 1
D
A.C. PVMT
PARKING LOT
PROPERTY LINE
N 03°01'48"E 134.58'
N 05°32'20"E 150.26'
S 84°27'12"E 363.78'
SET N&T RCE
SET L&T RCE
ALLEY
PHASE 1 - NEW RETAINING WALL

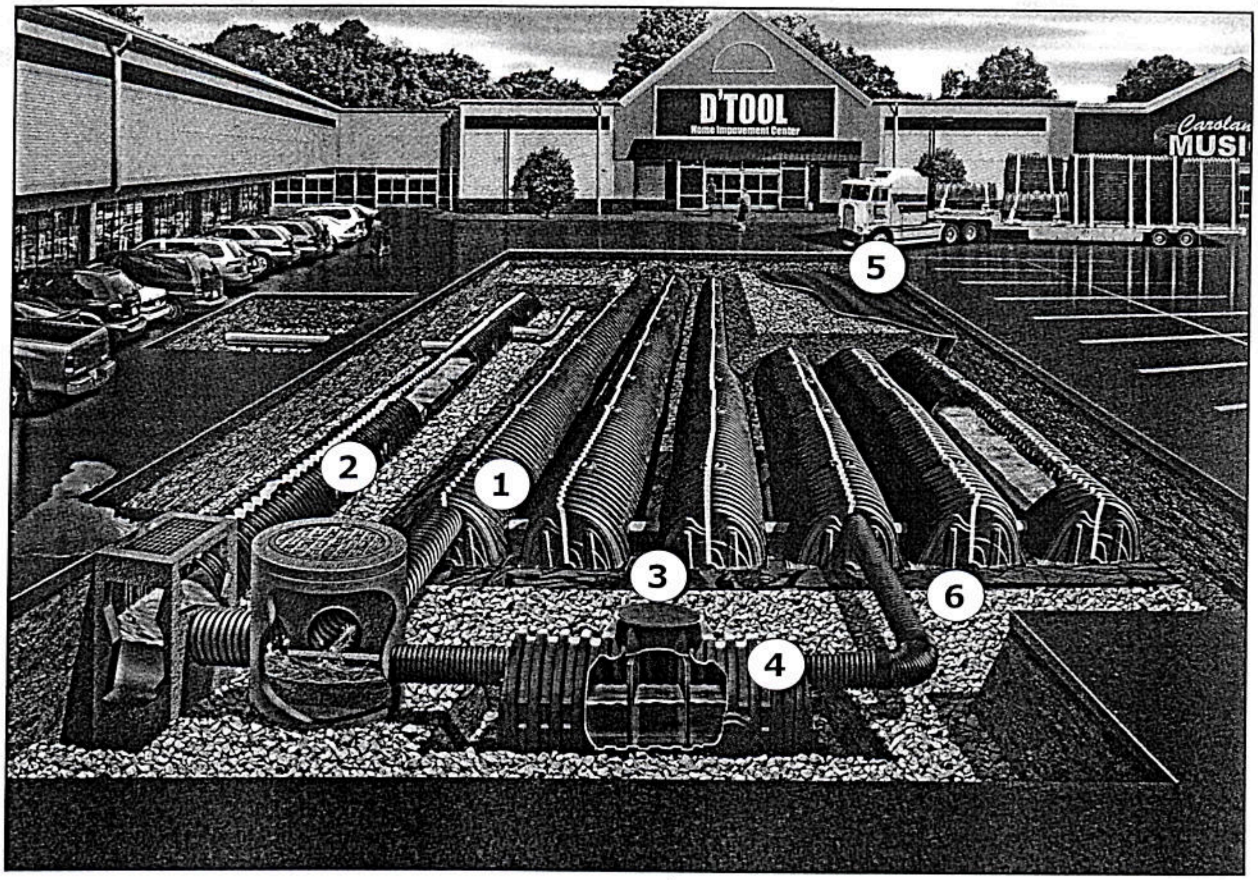
TABLE I-4
DESIGN CRITERIA
OF 5 TYPICAL SOILS

Type of Soil	Required sq. ft. of leaching area/100 gals. (m^2/L)	Maximum absorption capacity gals./sq. ft. of leaching area for a 24 hr. period (L/m^2)
1. Coarse sand or gravel	20 (.005)	5 (203.7)
2. Fine sand	25 (.006)	4 (162.9)
3. Sandy loam or sandy clay	40 (.010)	2.5 (101.9)
4. Clay with considerable sand or gravel	90 (.022)	1.10 (44.8)
5. Clay with small amount of sand or gravel	120 (.029)	0.83 (33.8)

TABLE I-5

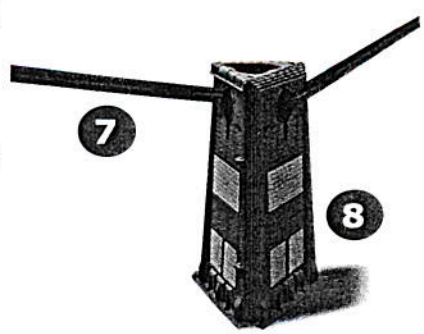
Required sq. ft. of Leaching Area/100 gals Septic Tank Capacity	(m^2/L)	Maximum Septic Tank Size Allowable	(liters)
20-25	(.005-.006)	7500	(28387.5)
40	(.010)	5000	(18925)
90	(.022)	3500	(13247.5)
120	(.030)	3000	(11355)

CULTEC



Typical CULTEC Stormwater System Components

1. CULTEC Stormwater Chamber - used for retention, detention, reclamation
2. CULTEC PAC™ 150 - chamber with bottom used for water conveyance
3. CULTEC HVLV™ Feed Connector - internal manifold component
4. CULTEC StormFilter™ 330 - Water Quality Unit
5. CULTEC No. 410™ Filter Fabric - prevents soil intrusion into system
6. CULTEC No. 20L™ Polyethylene Liner - placed under CULTEC manifold components, prevents scouring
7. CULTEC Warning Tape - Marks off location of underground CULTEC Stormwater System during construction to prevent vehicular traffic
8. Multicade™ Pylon - Marks location of underground CULTEC Stormwater System during construction phase



Minimum Fill Requirements

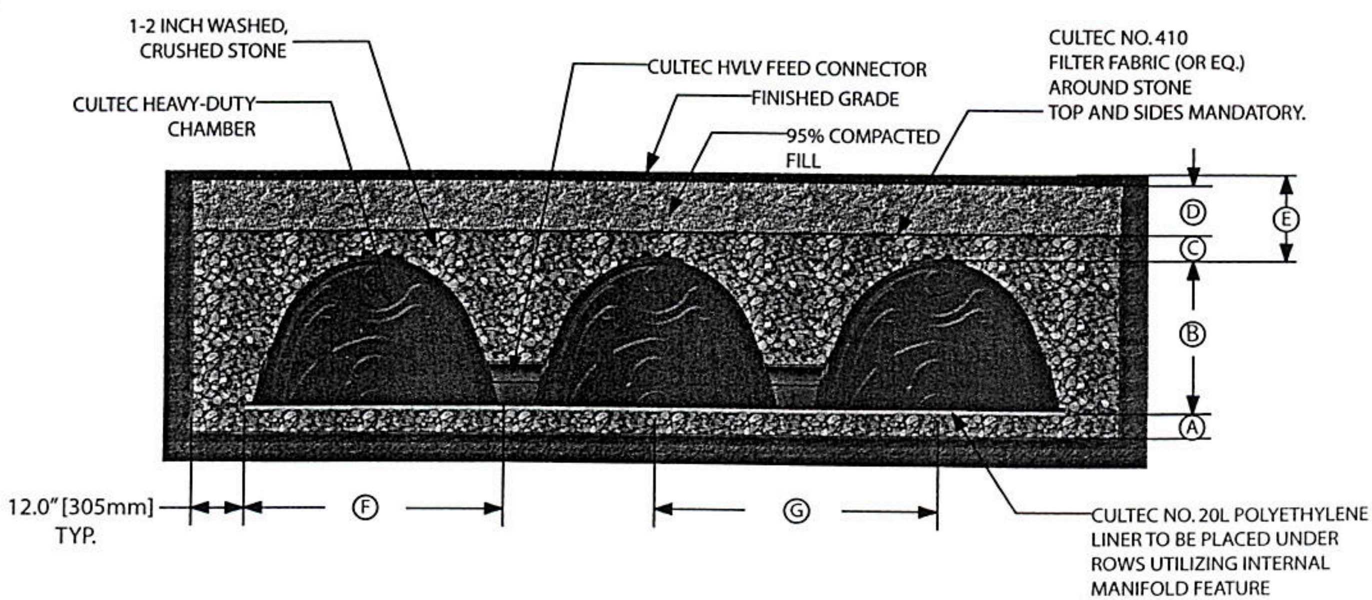
These requirements are for paved traffic applications only. If these models and design parameters do not meet your needs, please call CULTEC's Technical Department at 1-800-4-CULTEC, Ext. 2003 (1-800-428-5832, Ext. 2003) for further information and assistance.

Refer to CULTEC's most current installation instructions for further details including but not limited to acceptable fill materials and vehicle loads.

Table 1

	See Fig. 1	Contactor® 100HD	Recharger® 150HD	* Recharger® 280HD	Recharger® 330XLHD	Recharger® V8HD
Typical Center to Center Spacing	G	3.33′ 1.02 m	3.25′ 0.99 m	4.33′ 1.32 m	4.83′ 1.47 m	5.5′ 1.68 m
Chamber width	F	36″ 914 mm	33″ 838 mm	47″ 1194 mm	52″ 1321 mm	60″ 1524 mm
Max. depth of cover allowed above crown of chamber	E	14′ 4.27 m	14′ 4.27 m	14′ 4.27 m	12′ 3.66 m	12′ 3.66 m
Min. depth required of 95% Compacted Fill for Paved Traffic Application	D	8″ 203 mm	8″ 203 mm	8″ 203 mm	10″ 254 mm	12″ 305 mm
Min. depth of stone required above units for traffic applications	C	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm
Chamber height	B	12.5″ 318 mm	18.5″ 470 mm	26.5″ 673 mm	30.5″ 775 mm	32″ 813 mm
Min. depth of stone base	A	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm	6″ 152 mm

Fig. 1



CULTEC

System Sizing Calculations

For more detailed calculations you may use our MS-Excel based CULTEC Stormwater Design Calculator at **www.cultec.com** or contact our Technical Department for free design assistance.

We are also modeled in HydroCAD®, BOSS International's StormNET®, Bentley Systems' PondPack® and Streamline Technologies' ICPR® modeling software.

Separate calculations will be listed for the Recharger® V8 series because of its unique chamber length characteristics.

For Recharger V8HD System Sizing Calculations, refer to Pages 20-24.

Other models are available, ask our Technical Department if you need further information.

Bed Area and Quantity of Stone Required will be increased by the required min. 1 foot (305 mm) stone border and installed chamber length adjustments - *not calculated below.*

Volume of Excavation will be increased by the required min. 1 foot (305 mm) stone border and final backfill requirements - *not included below.*

Determine the Required Storage Volume (V_s)

Required Storage Volume (Vs) = Given

Determine the Number of Chambers Required (C)

Number of Chambers Required (C) C = Required Storage Volume ÷ Chamber and Stone Base Storage per Unit

$C = V_s \div D_u$

Table 2

	Bare Chamber Storage	Chamber and Stone Base Storage per Unit (D_u) 6" 152 mm	12" 305 mm	18" 457 mm
Contactor® 100HD	14 ft^3 0.4 m^3	28.81 ft^3 0.82 m^3	33.81 ft^3 0.96 m^3	38.81 ft^3 1.10 m^3
Recharger® 150HD	19.88 ft^3 0.56 m^3	36.71 ft^3 1.04 m^3	41.58 ft^3 1.18 m^3	46.46 ft^3 1.32 m^3
Recharger® 280HD	42.55 ft^3 1.21 m^3	64.46 ft^3 1.83 m^3	70.53 ft^3 2 m^3	76.59 ft^3 2.17 m^3
Recharger® 330XLHD	52.21 ft^3 1.48 m^3	79.26 ft^3 2.24 m^3	86.03 ft^3 2.44 m^3	92.79 ft^3 2.63 m^3

This is an approximation only. Actual number of chambers required may be reduced when stone border storage and chamber length adjustments per row are calculated. The Chamber and Stone Base Storages above are based on the installed chamber length, stone base as listed in the table, 6" (152 mm) stone above the unit and typical center to center spacing. Assumes 40% stone void.

DESIGN